

REMARKS

The Applicants thank the Examiner for the careful examination of this application and respectfully request the entry of the amendments indicated hereinabove.

Claims 1-8 are pending and rejected. Claim 5 is amended hereinabove.

Independent Claim 1 positively recites depositing a first layer of copper grains having a first initial grain size over a copper seed layer, the first layer of copper grains being deposited by an electroplating process; and depositing a second layer of copper grains having a second initial grain size over the first layer of copper grains, the second layer of copper grains being deposited by an electroplating process. These advantageously claimed features are not taught or suggested by the patent granted to Park et al.

Park et al. teaches away from the advantageously claimed invention by teaching the formation of a second Cu layer 130 over a first Cu layer 110 in which the copper grains of the first copper layer 100 were changed by the annealing process to form the first copper layer 110 (column 2 lines 36-38 and 64-66, column 3 lines 32-34, column 6 lines 12 and 33-35, FIGS. 5-6), but not the formation of a second layer of copper grains over a first layer of copper grains (that have not

been modified by the annealing process – i.e. element 100), which is advantageously claimed. This is because Park et al. teaches an annealing step that is a “necessary” treatment following the deposition of the first layer of Cu grains (column 4 lines 32-34 and 45-47, column 5 lines 49-54, see also column 2 lines 34-35 and 61-65 and column 3 lines 29-31). In summary, Park et al. teaches away from the advantageously claimed invention because Park et al. states that an annealing step between the deposition of the first and second layer of copper film is a “necessary” step after the deposition of the first electroplating film and before the deposition of the second copper film in order to “form a stable and generally void-free structure that, after annealing, is compatible with a subsequent thicker (large-grained) Cu layer created in a next cavity-filling deposition process” (column 4 lines 36-39, see also column 5 lines 50-54). The Applicants submit that the advantageously claimed process - whereby there is no anneal step between the formation of the first and second layer of copper grains - avoids the problem of the unwanted insulating copper oxide film that is noted in Park et al. (column 6 lines 14-18).

Regarding Claim 5, the Applicants respectfully traverse the assertion in the Office Action (page 3) that Park et al. teaches the step of annealing the semiconductor wafer after the deposition of the second metal film. The Applicants submit that Park et al. only teaches the use of an anneal step after the deposition of the first metal film (column 2 lines 35-36 and 62-64, column 3 lines 29-33,

column 4 lines 36-37, column 5 lines 49-51). Furthermore, the Applicants submit that Park et al. teaches away from the use of an anneal step after the deposition of the second metal film (column 2 lines 38-39 and 66-67, column 3 lines 34-36).

Therefore, the Applicants respectfully traverse the Examiner's rejection of Claim 1 and respectfully assert that Claim 1 is patentable over the patent granted to Park et al. Furthermore, Claims 2-6 are allowable for depending on allowable independent Claim 1 and, in combination, including limitations not taught or described in the references of record.

Independent Claim 7 positively recites depositing at least one additional layer of copper grains of differing initial grain sizes over the first layer of copper grains, the at least one additional layer of copper grains being deposited by an electroplating process. These advantageously claimed features are not taught or suggested by the patent granted to Park et al.

Park et al. teaches away from the advantageously claimed invention by teaching the formation of a second Cu layer 130 over a first Cu layer 110 in which the copper grains of the first copper layer 100 were changed by the annealing process to form the first copper layer 110 (column 2 lines 36-38 and 64-66, column 3 lines 32-34, column 6 lines 12 and 33-35, FIGS. 5-6), but not the formation of a second layer of copper grains over a first layer of copper grains (that have not

been modified by the annealing process), which is advantageously claimed. This is because Park et al. teaches an annealing step that is a "necessary" treatment following the deposition of the first layer of Cu grains (column 4 lines 32-34 and 45-47, column 5 lines 49-54, see also column 2 lines 34-35 and 61-65 and column 3 lines 29-31). In summary, Park et al. teaches away from the advantageously claimed invention because Park et al. states that an annealing step between the deposition of the first and second layer of copper film is a "necessary" step after the deposition of the first electroplating film and before the deposition of the second copper film (column 4 lines 36-39, see also column 5 lines 50-54).

Therefore, the Applicants respectfully traverse the Examiner's rejection of Claim 7 and respectfully assert that Claim 7 is patentable over the patent granted to Park et al.

Independent Claim 8 positively recites depositing a second layer of copper grains having a second initial grain size over the first layer of copper grains. In addition, Claim 8 positively recites the step of annealing the semiconductor wafer after the step of depositing the second layer of copper grains. These advantageously claimed features are not taught or suggested by the patent granted to Park et al.

Park et al. teaches away from the advantageously claimed invention by teaching the formation of a second Cu layer 130 over a first Cu layer 110 in which the copper grains of the first copper layer 100 were changed by the annealing process to form the first copper layer 110 (column 2 lines 36-38 and 64-66, column 3 lines 32-34, column 6 lines 12 and 33-35, FIGS. 5-6), but not the formation of a second layer of copper grains over a first layer of copper grains (that have not been modified by the annealing process), which is advantageously claimed. This is because Park et al. teaches an annealing step that is a "necessary" treatment following the deposition of the first layer of Cu grains (column 4 lines 32-34 and 45-47, column 5 lines 49-54, see also column 2 lines 34-35 and 61-65 and column 3 lines 29-31). In summary, Park et al. teaches away from the advantageously claimed invention because Park et al. states that an annealing step between the deposition of the first and second layer of copper film is a "necessary" step after the deposition of the first electroplating film and before the deposition of the second copper film (column 4 lines 36-39, see also column 5 lines 50-54).

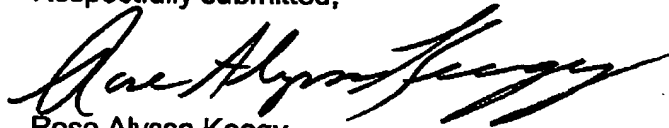
The Applicants respectfully traverse the assertion in the Office Action (page 4 that Park et al. teaches - in column 5 lines 49-50 - the step of annealing the semiconductor wafer after the deposition of the second metal film. The Applicants submit that Park et al. only teaches the use of an anneal step after the deposition of the first metal film (column 2 lines 35-36 and 62-64, column 3 lines 29-33, column 4 lines 36-37, column 5 lines 49-51). Furthermore, the Applicants submit

that Park et al. teaches away from the use of an anneal step after the deposition of the second metal film (column 2 lines 38-39 and 66-67, column 3 lines 34-36).

Therefore, the Applicants respectfully traverse the Examiner's rejection of Claim 8 and respectfully assert that Claim 8 is patentable over the patent granted to Park et al.

For the reasons stated above, this application is believed to be in condition for allowance. Reexamination and reconsideration is requested.

Respectfully submitted,



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